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USIB-D-41.18/8
(COMOR-D-56/70)
21 January 1965
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UNITED STATES INTELLIGENCE BOARD

MEMORANDUM FOR THE UNITED STATES INTELLIGENCE BOARD

SUBJECT : Statistical Evaluation of the First Fourteen
GAMBIT Missions

REFERENCES : a. USIB-D-41.18/6 (COMOR-D-56/68)
5 January 1965, Limited Distribution
b. USIB-D-41.18/7 (COMOR-D-56/69)
7 January 1965, Limited Distribution

1. The attached memorandum on the subject from the Committee on Overhead Reconnaissance (COMOR) in response to the USIB decision in paragraph 5. c. of reference b. is circulated for information and noting by the United States Intelligence Board (USIB).

2. The attachment is a coordinated replacement for the previous evaluation circulated by reference a.

3. This item will be placed on USIB agenda for noting at the meeting of 27 January 1965.

Attachment

Executive Secretary

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MEMORANDUM FOR: United States Intelligence Board

SUBJECT: Statistical Evaluation of the First
Fourteen GAMBIT Missions

REFERENCES: a. USIB-D-41.18/6; COMOR-D-56/68
b. USIB-D-41.18/7; COMOR-D-56/69

1. At the meeting of the Board on 6 January the Board considered a memorandum (reference a) on the above subject which had been prepared at the request of the Chairman of the Board. At the meeting the Board deferred action and referred the paper to the Committee on Overhead Reconnaissance for review and coordination with the assistance of the (S) National Reconnaissance Office (see reference b).

2. The action requested by the Board has now been accomplished and the paper as revised is submitted to the Board for such action as it may wish to take.


James Q. Reber
Chairman
Committee on Overhead Reconnaissance

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Tab A

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Statistical Evaluation of the First Fourteen GAMBIT Missions

1. The purpose of this study is to evaluate the degree to which individual GAMBIT missions and the program as a whole have responded to requirements submitted by the COMOR. Whenever possible it indicates some of the factors which have affected performance. The analysis is based primarily on the photographic results as reported by NPIC in OAKs and MCIs and to a lesser degree on post-mission information furnished the COMOR by the (S) NRO.

2. General information for the first fourteen GAMBIT missions is as follows:

<u>Missions</u>	<u>Launch Date</u>	<u>Days Scheduled</u>	<u>Days Operated</u>	<u>Recovered</u>	<u>Remarks</u>
4001	12 Jul 63	1	1	Yes	One day mission, No roll capability planned, Vehicle became unstable at pass 9, 3 targets reported
4002	6 Sep 63	3	2	Yes	No roll planned, 10 targets reported
4003	25 Oct 63	2	2	Yes	No roll planned, 2 targets reported
4004	18 Dec 63	2	1	Yes	Orbit control vehicle became unstable on pass 4, No targets reported
4005	25 Feb 64	2	2*	Yes	Improper commands sent from ground caused a yaw error, 1st roll attempts, smeared photos
4006	11 Mar 64	3	3	Yes	170 targets reported
4007	23 Apr 64	3	4	Yes	206 targets reported

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<u>Missions</u>	<u>Launch Date</u>	<u>Days Scheduled</u>	<u>Days Operated</u>	<u>Recovered</u>	<u>Remarks</u>
4008	19 May 64	4	2*	Yes	Orbit control vehicle became unstable on pass 16, 52 targets reported
4009	6 Jul 64	4	2	Yes	Orbit control vehicle unstable, No targets reported
4010	14 Aug 64	5	4**	Yes (4th day)	Command problems 66 targets reported
4011	24 Sep 64	5	4	Yes	244 targets reported
4012	8 Oct 64	5	0	No	Agena failure
4013	23 Oct 64	4	4	No	Recovery sequence failed
4014	4 Dec 64	4	1	Yes	Power failure to stabilization systems, 35 targets reported

*Only day 1 had successful camera operations.

**Only 2 days had successful camera operations.

3. a. To summarize the above it can be noted that no GAMBIT mission to date can be considered as having achieved its full potential. Due to system malfunctions, no useable photographs were obtained from Missions 4004, 4005, 4009, 4012, and 4013.

b. Missions 4001 through 4003 were not programmed to roll; consequently, they were able to photograph only the limited number of assigned targets within the 10 to 12 mile photo swath lying directly under their tracks. This feature, in conjunction with the fact that they were planned for short duration, accounted for the limited number of targets acquired.

c. Missions 4008, 4010, and 4014, while enhanced by the camera roll capabilities, suffered from technical difficulties and;

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d. Missions 4006 and 4007 were scheduled to operate three days. Mission 4011 was planned for five days and remained on orbit four days.

4. The tables which follow present detailed data related to the degree to which the GAMBIT program has responded to intelligence requirements. They include information on the number of targets obtained in stereo and mono; the number of targets photographed in clear weather, in scattered clouds, in total cloud cover; and the number of priority targets covered. An attempt is also made to determine the reasons underlying failure to obtain photography on priority targets.

5. Effect of Priorities on Target Coverage

(Stereo and Mono, 1st 3 Priorities, All Weather)

<u>Mission</u>	<u>Assigned Priority</u>	<u>Priority Targets Photographed</u>	<u>Per Cent</u>
4002	Not available*	5	--
4003	Not available*	3	--
4006	93	54	58
4007	186	99	54
4008	154	20	13
4010	181	16	9
4011	195	93	48
4014	257	30	12

*Because they were assigned before target files were maintained by the use of the computer and the detailed records were not kept.

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As may be noted in the preceding table, different numbers of priority targets were assigned for the individual missions. Priorities were established based on intelligence requirements (modified in some cases by knowledge of the planned mission ephemeris which permitted insight into mission capability) and the practice of using target priorities to assist in obtaining maximum utilization of camera operations available. It demonstrates the responsiveness of the camera programming to the guidance submitted via target priorities and also demonstrates that pointing accuracy can be expected. In general the success of a given mission is directly related to proper functioning as designed and to the length of time in orbit. In the cases of Missions 4008, 4010 and 4014 limited target coverage was caused by the fact that these missions were hampered by technical difficulties and were recovered after only one or two days in orbit.

6. Effect of Specific Priority Values on Target Coverage
(Stereo and Mono, All Weather)

Mission	Number of Priority 1 Targets	Photo- graphed	Per Cent	Number of Priority 2 Targets	Photo- graphed	Per Cent	Number of Priority 3 Targets	Photo- graphed	Per Cent
4006	32	21	66	40	22	55	21	11	52
4007	28	22	79	63	30	48	95	47	49
4008	16	3	19	48	7	15	90	10	11
4010	30	6	20	56	2	4	95	8	8
4011	55	35	64	42	19	45	98	39	40
4014	56	8	15	69	11	16	132	11	9

As the above table shows, there is a higher degree of success in obtaining coverage of first priority targets than those assigned Priorities 2 and 3. This is part of the GAMBIT system design and obviously is working. As many as possible of the Priority 1 targets were used in the orbit select program (TOSP). It should be noted that success in obtaining photography of first priority targets is directly related to mission duration. Inclusion of these targets in this program almost guarantees that the mission will be programmed to fly in such proximity to them that photography can be obtained. In fact, had these missions successfully flown for the time planned, it is estimated that

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nearly all of the first priority targets would have been photographed. Ephemeris data were provided the COMOR for use in planning two early GAMBIT missions (4005 and 4006). These data were not available for missions 4007 - 4010; and as a result, target priorities were assigned without benefit of knowing the planned track. Insofar as Mission 4011 is concerned, it is believed that the high degree of success in photographing priority targets can be credited to the fact that pre-mission ephemeris information again was provided to COMOR for use in the assignment of target priorities and to the fact that the mission was on orbit four days.

7. Responsiveness to Requirements for Stereo
(All Weather, 1st 3 Priorities)

<u>Mission</u>	<u>Priority Targets Photographed</u>	<u>Stereo</u>	<u>Mono</u>
4002	5	5	0
4003	3	3	0
4006	54	45	9
4007	99	76	23
4008	20	17	3
4010	16	12	4
4011	93	83	10
4014	30	13	17

The above table demonstrates that the GAMBIT system has the capability to photograph a high percentage of targets in stereo when that mode is stipulated by the COMOR. It does not answer the question of the number of lower priority targets that could have been photographed in mono had mono coverage of high priority targets been authorized.

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8.

Weather Distribution

(Stereo and Mono, 1st 3 Priorities)

<u>Mission</u>	<u>Total</u>	<u>Clear</u>	<u>Scattered Clouds</u>	<u>Obscured</u>
4002	5	5	0	0
4003	3	1	0	2
4006	54	26	9	19
4007	99	55	10	34
4008	20	7	1	12
4010	16	12	2	2
4011	93	38	11	44
4014	30	3	5	22

Since the GAMBIT system is limited by factors other than film, no efforts are made to conserve film over targets anticipated to be covered by bad weather. Until ways are found to increase mission life, it appears that little advantage will accrue in playing weather as is accomplished in the management of the CORONA system. However, COMOR authorizes the Satellite Operations Center to adjust target priorities as necessary to maximize forecast favorable weather.

9. Reasons Priority Targets were not Photographed

<u>Mission</u>	<u>Priority Targets not Photographed</u>	<u>Out of Camera Range</u>	<u>Competition with same or Higher Priority</u>	<u>Competition with Lower Priority</u>	<u>Undetermined</u>
4006	39	18	2	3	16
4007	87	42	12	4	29
4008	134	118	5	5	6
4010	165	151	7	3	4
4011	102	38	36	6	22
4014	227	211	9	6	1

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The preceding table demonstrates the impact of short mission life and target conflict on obtaining coverage of priority targets. On Missions 4008, 4010, and 4014 which only flew one or two days, most targets missed were beyond the swath width of the limited number of passes flown. On the other hand, the longer life missions (4006, 4007 and 4011) were affected to considerable extent by target conflicts caused by geographic location. This competition will continue to be troublesome until more targets have received first-time GAMBIT coverage, at which time their priority will be reduced so as to avoid conflict.

10. Conclusions:

a. The GAMBIT missions which have been recovered have demonstrated that the system has the capability to respond to the priority guidance provided by COMOR. An improvement in priority target collection has been noted as the COMOR and (S) NRO have gained experience in using mission data including nominal ephemeris in assignment of target priorities.

b. Until GAMBIT missions regularly can be flown for a duration of four or five days, it appears a limited number of targets will be photographed.

c. Because of inherent system's limitations (narrow swath width and noncontiguous photos), the number of targets will be limited. For this reason the selection and adjustment of target priorities is very important to the successful management of the GAMBIT payloads.


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Tab B

Statistical Evaluation of GAMBIT Mission 4011

1. The purpose of this study is to evaluate the degree to which Mission 4011 responded to COMOR requirements as a whole while giving particular attention to two "principal targets" which were difficult to photograph on the same mission. Whenever possible, it indicates some of the factors which have affected performance. The analysis is based primarily on the photographic results as reported by NPIC in the OAK and the MCI and to a lesser degree on post-mission information furnished the COMOR by the (S) NRO.

2. Mission 4011 was scheduled to fly five days against a total of 2796 targets assigned priorities as follows:

<u>Priority</u>	<u>Number of Targets</u>
1a	2
1b	27
1c	26
2	42
3	98
4	2456
5	145

3. As indicated in paragraph 1, priority assignments were influenced by the following major considerations:

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b. The priority values actually assigned were often selected so as to maximize camera operations and thus acquire photography of the greatest number of targets possible. This use of priorities sometimes resulted in a relatively low priority target being assigned a high priority to assure the camera's being turned on over locations where a number of targets could be photographed on one burst. On the other hand, some targets, which because of intelligence importance merited a high priority, were not assigned that priority since their geographic location permitted a picture to be taken even with low priority.

c. In addition, to assure maximum intelligence take in case the actual orbit deviated from that planned, an attempt was made to "salvage" by assigning priorities which would result in the programming of very important but lower priority targets. As a result, the number of high priority targets was artificially increased (even to the point of creating high priority target conflicts if the mission performed as planned). As missions progress, the Satellite Operations Center is authorized to adjust priorities as necessary to obtain maximum target coverage.

d. The lowest priority was assigned those targets previously photographed by GAMBIT missions but of sufficient intelligence interest as to warrant recoverage if not in conflict with other targets.

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4. The following table contains details of targets photographed showing coverage by priority, mode of coverage (stereo and mono) and existing weather.

	a	Priority 1			Priority		TOTAL 1-3	Priority		TOTAL
		b	c	Total	2	3		4	5	
Total Targets Submitted	2	27	26	55	42	98	195	2456	145	2796
Targets Photographed in Stereo	2	18	11	31	16	36	83	253	14	350
Clear	2	7	4	13	9	11	33	79	8	120
Scattered Clouds		2	2	4		2	6	28	2	36
Obscured by Clouds		9	5	14	7	23	44	146	4	194
Targets Photographed in Mono		2	2	4	3	3	10	145	18	173
Clear		2	1	3		2	5	48	2	55
Scattered Clouds			1	1	3	1	5	24	4	33
Obscured by Clouds								73	12	85
TOTAL Targets Photographed	2	20	13	35 ^a	19	39	93 ^b	398	32	523 ^c

a - 65% of Priority 1 targets

b - 48% of Priorities 1 - 3

c - 19% of all targets

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5. a. As also shown in the above table, a greater percentage of targets in high priority categories were photographed than were those in lower priority categories. This occurred in part because there were a greater number of lesser priority targets in competition for coverage by the limited number of camera operations available. It also occurred for the reasons explained in paragraphs 3b and c above.

b. At the time of launch of Mission 4011, the USIB requirement stipulated that stereo photography was required on all high priority targets. As indicated in the table, this mission photographed 83 targets in stereo, 44 of which were obscured by cloud cover. Ten priority targets were reported by NPIC as covered by mono rather than stereo photography. However, the mission data provided COMOR by the (S) NRO indicates that stereo photography was attempted of these same targets. In our investigation we considered the possibility that cloud cover over one portion of what should have been a stereo pair precluded acquisition of stereo coverage. This apparently occurred on five of the targets (those covered with scattered clouds) leaving five which we must conclude were simply missed in stereo.

6. The following table provides an analysis of the reason for failure to obtain photography of priority targets. It should be noted that a substantial number of the targets not photographed (about one-third) were in conflict with targets of higher priority.

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Reason for Failure to Obtain Photography	Priority 1				Priority 2	Priority 3	TOTAL
	a	b	c	Total			
a. Beyond Range *		6	3	9	5	24	38
b. Conflict with Higher Priority Target			2	2	13	19	34
c. Conflict with Equal Priority Target					2	6	8
d. Undetermined		1	8	9	3	10	22
TOTAL		7	13	20	23	59	102

*Caused in part by failure to fly full five days.

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Performance of Mission 4011

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COMOR Targets within Camera Range

(All Weather)

Day	Pass	Camera Operations Possible ^a	Camera Operations Accomplished ^b	COMOR Targets Assigned Preference	Preferred Targets Photographed ^c	Other COMOR Targets within Camera Range	Other COMOR Targets Photographed	Total COMOR Targets Photographed ^d
I		1	1	1	1	5	1	2
		5	1	0	0	1	1	1
		15	8	5	5	81	13	18
		25	8	3	3	23	9	12
		22	7	1	1	8	8	9
		15	8	2	2	39	16	18
		14	14	6	6	83	37	43
		9	8	7	6	216	31	37
TOTAL		106	55	25	24	456	116	140
II		2	2	0	0	4	2	2
		10	6	1	1	20	11	12
		12	6	2	2	49	20	22
		26	13	6	6	56	15	21
		21	6	2	2	19	5	7
		16	7	4	4	21	5	9
		14	14	7	7	142	29	36
		13	12	13	11	371	32	43
TOTAL	X	114	66	35	33	682	119	152

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Performance of Mission 4011

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COMOR Targets within Camera Range (cont.)

(All Weather)

Day	Pass	Camera Operations Possible ^a	Camera Operations Accomplished ^b	COMOR Targets Assigned Preference	Preferred Targets Photographed ^c	Other COMOR Targets within Camera Range	Other COMOR Targets Photographed	Total COMOR Targets Photographed ^d
III		1	1	1	1	1	1	2
		5	1	0	0	1	1	1
		10	6	2	2	36	11	13
		22	10	2	2	42	8	10
		20	7	1	1	9	6	7
		15	7	2	2	18	7	9
		20	14	8	8	46	13	21
		20	14	8	8	137	23	31
		6	4	2	2	40	4	6
TOTAL		119	64	26	26	380	74	100
IV		5	1	1	1	2	2	3
		5	3	0	0	3	2	2
		22	11	8	8	33	19	27
		25	10	3	3	33	6	9
		20	12	5	5	43	19	24
		20	11	9	8	57	16	24
		12	12	6	6	71	21	27
		4	4	3	3	39	5	8
TOTAL	X	113	64	36	34	281	90	124
Mission TOTAL	X	452	239	122	117	1799	399	516

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d. While the orbit adjust capability permitted good coverage or two very high priority targets, it must be recognized that its use caused orbit traces to group, thus severely limiting the geographic area brought within camera range.

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Footnotes to Foregoing Table

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- d. Additional targets would have come within camera range had this mission flown 5 days as planned and if the orbit adjust operations, required to obtain coverage of two principal targets as explained in Tab B, had not been undertaken.

8. Conclusions:

a. Based on the degree of success in acquiring photography of COMOR targets but excluding considerations related to photo quality (excessive IMC, poor resolution, low contrast, small scale, etc.), Mission 4011 must be considered to be the most effective of the GAMBIT series.

b. One reason for the high degree of success in acquiring desired photos can be attributed to the fact that pre-launch mission ephemeris was provided to the COMOR, thus enabling it to assign priorities in such a manner as to maximize the photographic take.

c. Mission 4011 demonstrated that the GAMBIT target-spotting and aiming system is extremely accurate. Furthermore, it confirmed that efforts to assign exact geographic coordinates to targets paid off, since a very high percentage of targets were so framed that stereo coverage was obtained.

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